ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

Generation IV Design & Evaluation Methods

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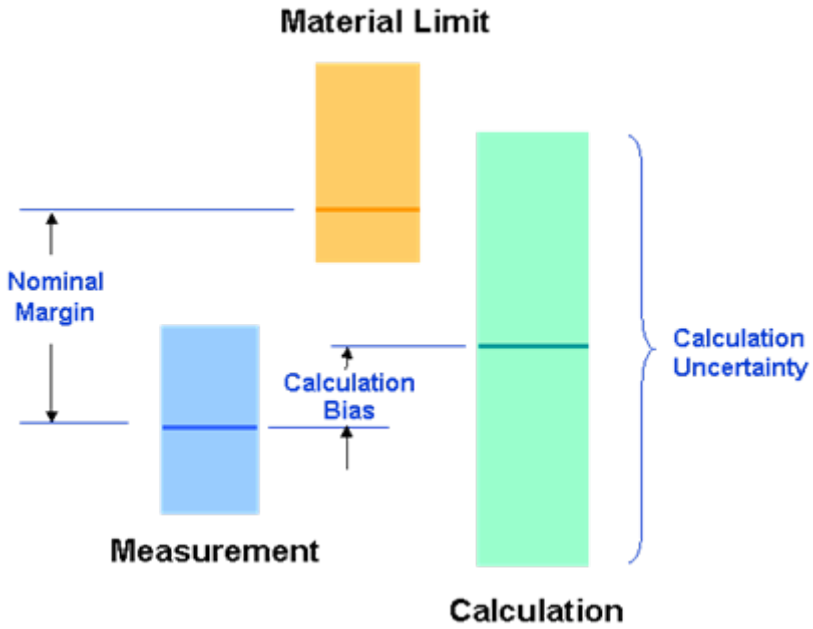
Overall Work Scope

- ***Design and safety analysis tools: modeling approaches, computer codes, databases***
  - *Specify analytical capabilities needed for design of Generation IV systems*
  - *Assess the adequacy of existing tools*
  - *Implement and qualify required improvements*



- ***Methodologies for evaluating system performance against Generation IV Technology Goals***
  - *GIF working groups formed to advance methodologies for*
    - *Economics*
    - *Proliferation Resistance & Physical Protection*
    - *Risk & Safety*

FY06 ACCOMPLISHMENTS: Design Methods

- ***Integral neutronic measurements***
  - *Completed analysis of first series of actinide reactivity worth measurements as part of OSMOSE collaboration with French CEA*
  - *Developed benchmark specifications based on HTR-10 initial criticality data*
  - *Analyzed integral measurements from critical facilities – VHTRC and HTR-PROTEUS*
- ***VHTR physics and fuel depletion code systems***
  - *Improved capabilities of existing code systems for neutronic analysis of prismatic block (PMR) and pebble bed (PBR) reactors*
- ***Thermo-fluid and safety related analysis***
  - *Further developed PIRT for VHTR operational and off-normal scenarios*
  - *Collected data at INL's MIR facility for testing of turbulent flow mixing models*
  - *Demonstrated utility of Argonne's NSTF facility for qualifying predicted performance of the Reactor Cavity Cooling System (RCCS)*
  - *Demonstrated coupling of system code (RELAP-5) and CFD code (FLUENT); used capability to model flow details in PMR lower plenum*

FY06 ACCOMPLISHMENTS: System Evaluation Methodologies

- ***Economics evaluation (EMWG)***
  - *Issued revision of GIF Cost Estimation Guidelines incorporating cost models for non-electricity energy products*
  - *Completed initial version of cost estimation software (G4-ECONS)*
  - *Completed sample cost calculation for JAEA advanced SFR concept*
- ***Proliferation Resistance & Physical Protection evaluation (PRPP WG)***
  - *Completed preliminary application studies for an example SFR system with collocated pyroprocessing facilities*
  - *Continued development of a methodology users' guide*
  - *Conducted workshop for users at JRC-Ispra*
- ***Risk and Safety evaluation (RSWG)***
  - *Emphasis is on achievement and demonstration of improved safety*
  - *Group is addressing system-specific and crosscutting safety issues, including safety goals, reliability of passive safety systems, approach to severe accidents, quality assurance standards*

Work in Progress for FY07

- ***Design Methods***
  - *Extend VHTR PIRT to include consideration of indirect power conversion cycle and water cooled RCCS*
  - *Perform sensitivity studies for key sequences identified in PIRT*
  - *Complete HTR-10 integral physics benchmark evaluation*
  - *Continue improvement and qualification of neutronic codes for analysis of PBR and PMR*

- ***Evaluation Methodologies***
  - *Complete EMWG cost estimation guidelines and software implementation in G4-ECONS*
  - *Develop more comprehensive test case for PR & PP methodology and further develop users' guide*
  - *Produce initial version of RSWG report addressing Generation IV safety objectives, their achievement, and evaluation approach*

Plans for FY08-09

- ***Design Methods***
  - *Assess and improve methods for nuclear data processing (spatial homogenization and energy condensation) for whole-core physics and depletion calculations*
  - *Conduct CFD code validation experiments and use measured results to assess existing CFD models and application practices*
  - *Assess and improve methods for coupled neutronic-thermal-fluidic analysis of operational, transient and accident sequences*
  - *Perform scaling analysis and conceptual design for an integral, electrically heated VHTR vessel and primary loop facility*

- ***Evaluation Methodologies***
  - *Anticipate shift in focus from methodology development to application studies, as an integral part of Generation IV system development*
  - *Quantitative methods for estimation of PR & PP measures*
  - *Economics (vs. costing) of non-electricity products and modular plants*
  - *Technology neutral risk and safety criteria*